# PUBLIC PAGE

**Quarterly Report**

Date of Report: April 15, 2008

Contract Number: DTPH56-05-T-0001
Prepared for: United States Department of Transportation
Pipeline and Hazardous Materials Safety Administration
Office of Pipeline Safety

Project Title: "Understanding Magnetic Flux Leakage (MFL) Signals from Mechanical Damage in Pipelines"

Prepared by: Dr. Lynann Clapham
Principal Investigator
Queen's University
Kingston, Ontario, Canada K7L 3N6
lynann@physics.queensu.ca

Mr. Ian Wood
Team Project Manager
Electricore, Inc.
27943 Smyth Drive, Suite 105
Valencia, CA 91355
ian@electricore.org

Mr. Mark Piazza
Team Technical Coordinator
Pipeline Research Council International, Inc.
1401 Wilson Blvd, Suite 1101
Arlington, VA 22209
mpiazza@prci.org

For quarterly period ending: March 31, 2008

## Background

In an effort to improve safety and minimize environmental impact, there is increasing emphasis of pipeline operators and inspection vendors to locate and accurately assess mechanical damage. Caliper tools can be used to predict sizes of simple dents, but cannot detect the presence of external gouging, corrosion pitting, stresses or cracking associated with those dents. MFL tools have the potential to characterize dents and gouges, but as yet the MFL signals from these features are not sufficiently understood to be used for reliable mechanical damage detection and characterization. In order to reliably use MFL tools for mechanical damage assessment, we need to understand the origin of the MFL signal from dents and gouges. This project addresses that need.

## Technical Status

Work this quarter focused on Task 9 "Characterizing Magnetic Response of Gouged Pipeline Material" and Task 13 "Collaboration with DOT Project DTPH56-06-T-000016".

The Magnetic Barkhausen Noise (MBN) equipment has been upgraded by replacing the old data acquisition software with new LabVIEW8.5 along with the compatible DAQmx from National Instruments, USA. A noisy bipolar power supply, filters, and monitor have been replaced. The old pick-up coils have been replaced by the new ones of inner diameter 1 mm, outer diameter 3 mm and about 200 turns (Tasks 9.1). Test gouges of different size, shape and severity have been produced in square steel pieces of length 18 inches and thickness 5 mm using backhoe tools (Task 9.2).

Geometrical specifications of few pipeline dents produced by using cylindrical, pointy, and wedge shaped indenters for MD1-1 project were received from Rosen USA, Inc. The structural finite element modeling of these dents was subcontracted to Mr. Mohamed El-Taher, a Ph.D. student working with Prof. Ian Moore of the Department of Civil Engineering, Queen's University, to obtain localized stress information in the dented vicinity. The results for most of these dents have been received (Task 13.1). A meeting with PRCI Mechanical Damage working group was held as a part of the Pipeline Program Technology Exchange Meeting from February 11-13 at Atlanta, Georgia.

## Plans for Future Activity

The following work is planned for the next quarter:

- Test gouges will be characterized using Magnetic Barkhausen Noise technique both on the outside and inside surfaces. The MBN data will be analyzed to extract stress information in the gouged region. This information will used in the magnetic finite element modeling (Task 9.3).
- Magnetic Flux Leakage technique will be employed to produce the MFL patterns on the test gouges. Both axial and radial components of the leakage flux density will be obtained on both sides of the gouges (Task 9.4).
- Both MBN and MFL results will be used to recognize geometry and stress effects separately. This information will be used to generate magnetic response and stress parameters for gouges for input into the MagNet finite element modeling software. Also, a comparison of the experimental MFL results and modeled results will be made (Task 9.5).
- The stress information obtained from structural modeling of MD1-1 dents will be used in the finite element magnetic modeling of MFL signals (geometry and stress components) of these dents and the results will be compared with the experimental results obtained from MD1-1 project team (Task 13.2).